ROCK DRILL BIT AND METHOD FOR THE MANUFACTURE THEREOF

[**0001**] This application claims priority under 35 U.S.C. §§ 119 and/or 365 to Patent Application Serial No. 0201984-2 filed in Sweden on June 26, 2002, the entire content of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[**0002**] The present invention relates to a rock drill bit for percussive drilling, especially top hammer drilling.

[**0003**] After the completion of a bore hole, the rock drill bit intended for percussive drilling, with the appurtenant drilling string, consisting of drill rods, should be removed from the bore hole. In that connection, the drill bit and the drilling string are usually rotated in the opposite direction compared to when drilling of the bore hole is effected. However, in connection with the removal of the rock drill bit from the bore hole, it may occur that rock material that has come loose from the hole wall makes the withdrawal of the drilling string and the drill bit more difficult. In order to overcome this problem, it is common that the drill bit at the rear end thereof, i.e., at the end facing away from the drill front, has cutting inserts or chisels, designated retrac teeth below, which during rotation of the drilling string and the drill bit, in connection with retracting the drilling string and the drill bit from the bore hole, crushes the rock material that has come loose from the bore wall. Said retrac teeth are made by means of special milling operations, thus constituting additional operations in addition to the prevalent operations for the manufacture of a rock drill bit of the type in question. However, the design of these known teeth at the rear end of the drill bit means that sharp corners are formed adjacent to said teeth. This in turn means that cracks are generated in connection with said teeth during operation of the rock drill bit.

[**0004**] By Hollar et al. U.S. Patent No. 5,743,345, a rock drill bit is previously known, which has an appurtenant drill rod, where the rock drill bit at the rear end thereof is provided with special cemented carbide pins that work in a way that corresponds to the above-described teeth at the rear end of the drill bit. To arrange special cemented carbide pins at the rear end of the rock drill bit, involves, however, a price rise at production of a rock drill bit of the type in question.

[**0005**] In SE-C2-514 931(corresponding to Åsberg et al. U.S. Patent No. 6,494,275), a rock drill bit of the present type is shown. The retrac teeth of the known rock drill bit have a tendency to break down. Furthermore, the retrac teeth of the known rock drill bit have turned out to be inadequate, from a cutting point of view.

OBJECTS OF THE INVENTION

[**0006**] The present invention has the object of providing a rock drill bit of the kind defined in the introduction, wherein the retrac teeth of said rock drill bit are so formed that the retrac teeth are reinforced.

[**0007**] Another object of the present invention is to provide a rock drill bit that permits good rock removal.

[**0008**] Still another object of the present invention is that the retrac teeth of the rock drill bit permits that transfer of shock wave energy between the drill rod situated closest to the drill bit and the drill bit takes place by means of a so-called shoulder stop.

SUMMARY OF THE INVENTION

[**0009**] One aspect of the present invention relates to a rock drill bit for percussive drilling which comprises a drill head that carries rock-removing members at a rock-removing end thereof and has a plurality of external grooves formed therein. The grooves extend generally in an axial direction

of the drill head for conducting cuttings. Lands are defined between adjacent pairs of the grooves and extend generally in the axial direction. The drill head further includes a connecting structure adapted to connect the drill head to a drill rod. The lands include rear end portions which define respective retrac teeth. Each retrac tooth has at least one cutting edge, a chip surface, and a clearance surface. The chip surface and the clearance surface form therebetween an edge angle no greater than 100°.

[0010] Another aspect of the invention involves a method for the manufacture of a rock drill bit for percussive drilling. The bit is machined from a cast workpiece to include a forward rock-removing section and an axially opposite rearward connecting section adapted for connecting the bit to a drill rod. The connecting section includes a recess having an internal screw thread. Cooling medium channels extend through the bit from the recess to a front end of the rock-removing section. The method comprises the steps of:

A) performing a turning operation on the workpiece at an exterior of the connecting section to generate a rearwardly facing end surface that is inclined toward the rock-removing section at an acute angle relative to a plane oriented perpendicular to a center axis of the bit; and

B) milling external grooves in the workpiece for conducting cuttings, wherein the exterior grooves extend along the rock-removing section and the connecting section and define lands therebetween that have ends facing rearwardly to define respective retrac teeth that have cutting edges extending generally axially along an envelope surface of the bit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] An embodiment of the rock drill bit according to the present invention will be described below, references being made to the accompanying drawings.

[0012] Fig. 1 shows a perspective view of a rock drill bit according to the present invention.

[0013] Fig. 2 shows a partial cross-section through the rock drill bit according to Fig. 1 and an appurtenant drill rod.

[0014] Fig. 3 shows a side view of the rock drill bit according to Fig. 1.

[0015] Fig. 4 shows an end view of the rock drill bit according to Fig. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

[0016] The rock drill bit 1 illustrated in Figs. 1-4 comprises a drill head 3 and a shank or a skirt 5, wherein the drill head 3 and the skirt 5 are integrated with each other. A drill rod 7 is connected to the rock drill bit 1 via a thread coupling. In the drill rod 7, a through-going flush duct 8 is arranged in the conventional way. A longitudinal center axis 2, common for the rock drill bit 1 and the drill rod 7, is drawn in Fig. 2.

[0017] As is most clearly seen in Fig. 2, the rock drill bit 1 includes a rear connecting end in which is formed a recess having an internal female thread 9, which receives an external male thread 10 at one end of the drill rod 7.

[0018] The drill head 3 of the rock drill bit 1 according to the present invention is provided with rock removing members in the conventional way, in the illustrated embodiment in the form of cemented carbide pins or buttons 11. A number of cooling medium channels 12 extends between the internal space of the rock drill bit 1, which is defined by the internal female thread 9, and the front of the drill head 3. In said internal space, a first stop face 13, a so-called bottom stop, is also arranged for the free end of the drill rod 7.

[0019] At the rear end of the rock drill bit 1, as is most clearly shown in Fig. 4, a second stop face 14, a so-called shoulder stop, is arranged, which is intended to interact with a shoulder 15 of the drill rod 7. In the illustrated embodiment, a so-called shoulder-bottom stop is frequently used, which

means that the drill rod 7 is manufactured with such tolerances that, at establishment of the threaded joint between the rock drill bit 1 and the drill rod 7, the free end of the drill rod 7 initially will come to abutment against the bottom stop 13. After a relatively short time of wearing-in of the threaded coupling, also the shoulder 15 of the drill rod 7 comes to abutment against the shoulder stop 14, wherein a so-called shoulder-bottom stop has been established, i.e., abutment between the rock drill bit 1 and the drill rod 7 takes place at both the bottom stop 13 and the shoulder stop 14. This means that transfer of shock wave energy from the drill rod 7 to the rock drill bit 1 will be effected via both the bottom stop 13 and the shoulder stop 14.

[0020] As is most clearly seen in Figs. 1 and 3, the rock drill bit 1 is on the outside thereof provided with a number of straight, front 16A and rear 16B grooves for conducting cuttings extending in the axial direction of the rock drill bit 1. Each front groove for cuttings 16A is symmetrically arranged in relation to a line parallel with the center axis 2. Each rear groove for cuttings 16B is asymmetrically arranged in relation to a line parallel with the center axis. Each rear groove for cuttings 16B consists of a first chip surface 31 and a second chip surface 32, which are substantially perpendicular to each other. The first chip surface 31 has a radial extension that runs substantially perpendicularly to the center axis 2. The cutting surfaces 31 and 32 meet in a rounded portion 33 that approaches the center axis 2 in the direction axially rearwards. Between themselves, the rear grooves for cuttings 16B define a number of substantially straight lands 17 that also extend in the axial direction of the rock drill bit 1. A substantially cylindrical countersunk portion 17A is arranged between the front and the rear grooves 16A and 16B, respectively. Among other things, the cylindrical portion 17A has the purpose of ensuring that guiding of the rock drill bit 1 in the bore hole is carried out by means of the portions that are located in connection with the ends of the rock drill bit 1, and decreasing the resistance against the release of cutting dust. The grooves 16A, 16B are in the conventional

manner intended to transport away the drill dust produced at the front of the rock drill bit 1.

[0021] The lands 17 are formed by retrac teeth 18, having the function of crushing the material that has come loose from the hole wall during withdrawal of the rock drill bit 1 from a drilled hole. Each retrac tooth 18 is provided with a first edge 19A, a second edge 19B and a third edge 19C. The first edge 19A is situated farthest forward in the direction of rotation R of the drill bit at each retrac tooth 18. The edge 19A is substantially parallel to the center axis 2. The edges 19A coincide with an imaginary cylinder that intersects the peripheral buttons 11 of the rock drill bit 1. The edge 19A is formed at the intersection between a chip surface 31 and a clearance or flank surface 30. The chip surface 31 and the clearance surface 30 form an edge angle ß, which is not greater than 100°, preferably not greater than 90°. The second edge 19B is positioned at the intersecting line between the chip surface and a substantially partially conical end surface 20. The second edge 19B is situated farthest back in the feeding direction of the drill bit on each land 17. The end surface 20 is arranged axially inside and radially outside of the second stop face 14. The end surface 20 is inclined generally forwardly toward the front end of the bit and forms an outer angle α greater than 180° with the second stop face 14. Stated another way, the end surface 20 forms an acute angle δ with a plane 21 oriented perpendicular to a longitudinal center axis 2 for the rock drill bit 1. The angle α is greater than 180°. Thus, the angle between the first 19A and the second edge 19B becomes obtuse, i.e. greater than 90°. The third edge 19C is situated farthest forward in the feeding direction of the drill bit, on each land 17. The edge 19C forms an acute angle with the center axis 2 and an obtuse angle with the first edge 19A.

[0022] The retrac teeth 18 according to the present invention may be created in a simple and efficient way in connection with the manufacture of the rock drill bit 1 according to the present invention. During said

manufacture, the end where the retrac teeth are to be formed is turned, wherein the second stop face 14 is provided, as well as a concentric, outer surface, which forms the angle α with the second stop face 14 that is greater than 180°. In a subsequent step in the manufacture of the rock drill bit 1 according to the present invention, the grooves for cuttings 16B are provided on the outside of the rock drill bit 1, preferably through milling. In that connection, the lands 17 situated between the grooves for cuttings 16B are automatically formed. In connection with the automatic forming of the lands 17, retrac teeth 18 are also automatically formed, see Figs. 2 and 3, at the ends of the lands 17 that are facing away from the rock removing end of the rock drill bit 1. By the geometry of the concentric, outer surface, the retrac teeth 18 will be formed with the edges 19A, 19B, 19C, said edges being positioned at the maximum diameter of the skirts 5, as well as inside of the same. Thereby, each retrac tooth 18 will also have a surface 20, generally facing away from the rock removing end of the rock drill bit 1, which surface is formed from the above-mentioned concentric, outer surface, i.e., the surface 20 also forms an angle α that is greater than 180° with the second stop face 14. The surfaces 20 are included in a cone, the imaginary cone tip of which is directed towards the threaded end of the bit 1. A substantial advantage of the retrac teeth 18 formed in this way is that there are substantially no sharp corners in connection with said teeth 18. Thereby, the risk of crack formations in connection with said retrac teeth 18 is to a large extent reduced.

[0023] In the above-described embodiment of the rock drill bit 1, the grooves for cuttings 16 and the lands 17 are straight, with an extension in the axial direction of the rock drill bit 1. However, within the scope of the present invention it is also feasible that the grooves for cuttings and the appurtenant lands could run, for instance, helically at the outside of the rock drill bit. The phrase "... extends in the axial direction of the rock drill bit ...", used in the claims, should be regarded as comprising also those cases

when the grooves for cuttings and the lands are not parallel to the center axis 2.

[**0024**] According to the above-described embodiment of the rock drill bit 1, retrac teeth 18 are formed between each adjacent pair of grooves for cuttings 16B. Within the scope of the present invention, it may however be conceived that for instance every second retrac tooth 18 is removed, wherein this conveniently is carried out by the fact that the end of a land 17 that is facing away from the rock removing end of the rock drill bit 1 is removed, conveniently by means of milling. The amount of retrac teeth 18 that a rock drill bit 1 according to the present invention should have is determined by a range of different parameters, wherein for exemplifying and not limiting purposes, the diameter of the drill bit, the type of rock in which the drilling takes place, as well as the drilling rig that is used, may be mentioned.

[**0025**] Although the present invention has been described in connection with preferred embodiments thereof, it will be appreciated by those skilled in the art that additions, deletions, modifications, and substitutions not specifically described may be made without departing from the spirit and scope of the invention as defined in the appended claims.